

PANEL DISCUSSION:

RESERVOIR MANAGEMENT: OPTIMIZATION VS. SIMULATION IN THE CONTEXT OF THE COMPREHENSIVE STUDY

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Moderator: Philip Karr, General Manager, Cobb-County-Marietta Water Authority, 1660 Barnes Mill Rd., Marietta, Georgia 30062.

Panel Discussions:

Allatoona Dam and Lake: A Perspective on History and Water Supply Usage, *Edmond Burkett, U. S. Army Corps of Engineers, Mobile District, P.O. Box 2288, Mobile, Alabama 36628.*

Analysis of the Operation of Lakes Lanier and Allatoona Using Optimization, *Aris Georgakakos, Associate Professor, Civil Engineering Dept., Georgia Institute of Technology, Atlanta, Georgia 30332.*

Analysis of the Operation of Lakes Lanier and Allatoona Using Simulation, *George McMahon, Camp Dresser and McKee, Inc., 2100 Riveredge Parkway, Suite 500, Atlanta, Georgia 30328.*

INTRODUCTION

Reservoir operation provides ample opportunity for using computer-aided management tools. Except for simple systems, namely, small single objective reservoirs, where optimal decisions are obvious, the decision making process must take into account a plethora of complicating factors. Uncertain inflows, reservoir and river dynamics, hydroelectric plant characteristics, flood and drought concerns, water supply, energy generation commitments and economics, water quality standards, recreational activities, local and regional water use conflicts and legislation, and public opinion are but a few of the parameters influencing reservoir management decisions. Computer-aided management tools including data management and interactive graphics systems and computer models are particularly useful to reservoir management

authorities for planning as well as operational purposes.

Computer models for reservoir systems analysis are usually classified as simulation and optimization models. Due to their simple logic, simulation models are more popular among practitioners, but actual usage of either type is still a rare occurrence. The primary reasons are that (a) practicing engineers are reluctant to abandon the traditional heuristic reservoir management methods in favor of sophisticated models that most have not been trained to use and (b) model developers are often unaware of the institutional environment in which management decisions are made in practice and fail to integrate their research products within it. However, the times when water was plentiful are bygone, and fierce water disputes are common to the United States and abroad. Water authorities can no longer be content with not making "bad" decisions; they are now expected to manage in the most efficient and equitable manner. In view of these expectations, computer models are no longer a luxury but an absolute necessity.

Simulation models are built to mimic how a water resources system responds to various hydrologic inputs, water use demands, and specific operational policies. In essence, they are an elaborate accounting scheme which keeps records of water volumes as they are added to, withdrawn, or pass through every system element. As such, they can incorporate a highly detailed system representation while being relatively easy to implement.

Optimization models are developed to systematically evaluate the impacts of potential operational policies. They, too, include a system-model, but their main goal is not to simulate as it is to determine desirable operational options. In systems with multiple objectives, the existence of one option superior to all others is very unlikely. This is especially true in reservoirs where conflicts almost always arise between hydropower and flood control, water supply and recreation, and hydropower and water conservation. To this end, the role of a decision model emerges as follows: First, the effects of various operational

scenarios can be explored and presented to the decision making authority for review. This information can take the form of tradeoffs depicting how various sets of priorities affect each system output. A tradeoff curve is the result of several optimization runs, each one of which operates under a difference set of objective priorities. After reviewing this information, the management authority can decide what constitutes a desirable compromise among water uses and select the most satisfying operational option.

Simulation models can also be used in the same manner but have to rely on trial-and-error to explore potential operational scenarios. In complex systems with many reservoirs and multiple objectives, this may not be feasible. On the other hand, it has been argued that the most efficient operational options are easily identifiable, and a simulation model can just as well be used. Finally, many simulation advocates claim that optimization models cannot effectively handle all reservoir system idiosyncracies. Twenty years ago, this was also acknowledged by optimization specialists. Today, after two decades of creative research breakthroughs and fascinating computer advances, this may be nothing more than an unfounded perception.

The relative strengths and weaknesses of simulation and optimization models will be debated in this session by a panel of experts. some implications for the "comprehensive Study" will also be discussed.